system control centre

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The System Control Centre — the nerve centre of Ontario Hydro's 250,000-square mile system — is located in a modest brick building near the busy intersection of Highways 27 and 401 on Metropolitan Toronto's outskirts.

Here, surrounded by an array of dials, meters, lights and graphs, sit the men who control the ebb and flow of electricity through 20,000 miles of transmission lines across the province.

Their job is to meet power demands efficiently and at the lowest possible cost 24 hours a day. Freezing rain, fog, high winds and mechanical failures are among their enemies.

At their command are 300 generators in 68 hydro-electric and seven thermal stations. They range in capacity up to 500,000 kilowatts per unit — enough power to supply a city of 320,000 homes. In emergencies, 27 standby combustion turbine units can be started up within a few minutes to help meet peak demands.

In addition, Ontario Hydro is directly interconnected with neighboring utility systems in Quebec, New York State, Michigan and Manitoba, which link its system to a vast Atlantic-to-Pacific power network comprising 40 per cent of the world's electrical capacity.

These interconnections permit power transfers to meet major contingencies such as the loss of several big generators and allow the shifting of power flows to maintain security of supply during emergencies such as the breakdown of an ice-coated transmission line. They also strengthen Hydro's system so that it can better withstand a major electrical disturbance.

customer calls tune

Electric power demands reflect life in Ontario like a heartbeat. The System Control Centre monitors that heartbeat so that the system can respond instantly to the changing needs of more than 2,300,000 customers in big cities, towns and rural areas. These include the customers of some 350 associated municipal electric utilities which buy power at cost from Hydro.

Every time you flick a switch, a remote generating station responds to your need for electric energy. When thousands of people do the same thing at the same time, the effect is remarkable.

On a cold, blustery winter day when street lights come on early, power demands soar to the daily peak. In summer the peak is just before noon.

Specific activities have a pronounced effect. Blue Monday — still a traditional washday for many housewives — brings additional demands for power to energize electric motors which drive laundry equipment and pump water to homes.

Demands jump suddenly between tense periods of a National Hockey League playoff game when people switch on lights, open the refrigerator or plug in electric kettles. They also rise when seesaw election returns or space exploration photos are screened later than usual TV viewing hours.

Whatever the cause, the total demand of electrical consumers dictates the pattern of action at the control centre. Besides a great deal of technical knowledge and operating experience, system control men must have insight into human behavior to anticipate and meet fluctuating demands. They are backed up by a security-conscious organization which employs specialists in many fields, such as meteorology, system planning and performance, computers, communications and protection and control.

security first

Security of service — an uninterrupted, safe flow of power to all customers when they need it — is the Control Centre's prime responsibility. Operating within prescribed safety limits, the next priority is the most efficient and economical use of Hydro's widely-separated generating resources.

Rigid limits are necessary to avoid interruptions, to protect expensive Hydro equipment and to ensure high standards of service suited to customers' needs.

In the Centre's brightly-lit control room, a handful of men keep their fingers on the electrical pulse of Canada's wealthiest province and direct the mammoth job of supplying diverse energy needs. Twenty-four hours a day, seven days a week, a four-man crew maintains a constant vigil on the flow of power with the help of a maze of control and communications equipment.

Two men are charged with the major responsibility of safeguarding system security and ensuring that power is instantly available to meet even the slightest increase in demand. The other two are their assistants.

The system supervisor has final responsibility for the system setup at all times. As "policeman", he sees that desired security is maintained, voltage is adequate and correct, and that loadings on transmission lines and generators are within safe limits.

When trouble occurs on Hydro's high tension network, he may assume complete control of the system until it has returned to an even keel.

the "power-broker"

The production supervisor is, in effect, a "power-broker." He is responsible for ensuring an adequate supply of power is available, minute by minute, for the coming hours of the day at minimum cost. In short, he keeps a constant watch on the system's economics.

In the process, he may buy power or sell power to a neighboring system. If at any given time a neighboring system has excess power at a lower cost than Hydro, he will buy this lower cost power for the benefit of Ontario consumers. And if Hydro has power surplus to its immediate needs, the "power-broker" will sell it rather than leave a generator idle.

To make wise use of resources, the production supervisor needs a sharp pencil because costs vary between stations and units of various size. Generally, Hydro's sales usually offset purchases made for economy or emergency purposes and create a balance in Hydro's favor at year's end.

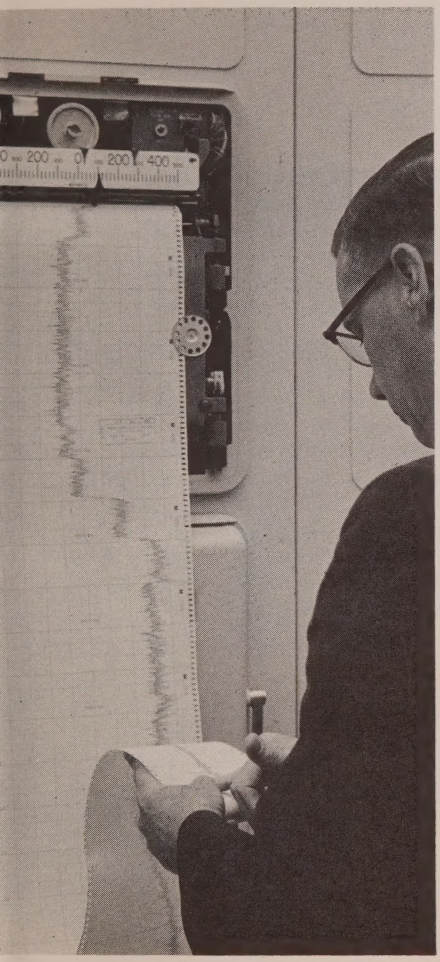
Power demands fall into two categories, usually referred to as base load and peak load. Base load is the continuous amount of power Hydro is required to provide at all times to meet everyday needs. Peak demands are the high points of a day, year or season. The yearly peak usually occurs about 5:15 p.m. on a cold and overcast December day.

Hydro-electric stations are ideal for meeting peak demands because water impounded behind a dam may be released to generate a large amount of electricity for several hours. Coal-fired plants, which require up to six hours to start up, are used mainly for base load but may be used for peaking. Nuclear stations are best suited for continuous operation.

An array of graphs and meters shows the production supervisor at a glance the condition of the system and the various factors which he must take into consideration minute by minute.

For example, a meter driven by a photo-electric cell on the control centre roof records the amount of sunlight. Graphs drawn by this meter are used in combination with weather forecasts to help forecast demands.

Other instruments indicate the actual



instantaneous load on each of Hydro's 230,000-volt lines interconnecting adjacent power systems. Another meter records the level of Lake Erie which determines how much water will be available within a few hours for Niagara hydro-electric plants.

pulse of the province

The production supervisor can see at a glance the amount of power being generated at Hydro's major stations and the moment-by-moment balance between demand and supply. When they match exactly, the frequency meter shows a constant 60 hertz (cycles a second).

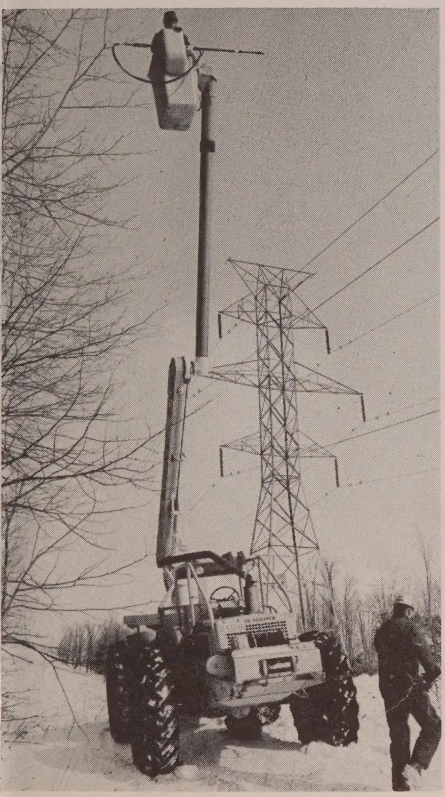
Theoretically, if a housewife turns on an electric stove, the balance will be upset. This imbalance is detected and analyzed by a computer which is programmed to order a remote generating station or stations operating as the system load control plant that more power is required and thus the balance is restored.

One or more plants are selected for automatic load control to meet minute-by-minute fluctuations in demand. With the load control facility at his fingertips, the production supervisor continuously keeps these regulating plants in a position to increase or decrease generation to meet these load fluctuations.

He uses the load control equipment to regulate desired power interchanges with interconnected systems, an important factor in system stability. If faster generating changes are required than the automatic equipment can accomplish, he pushes an emergency button to increase or decrease power output.

Frequency control maintains the accuracy of all electric clocks. If there's a fraction of a cycle deviation from 60 hertz, Hydro's control centre and the interconnected systems co-operate to correct the time error—limited to two seconds—by speeding up or slowing down all generators. The control centre checks the time against a standard clock, accurate to one second in 100,000.

behind the switch

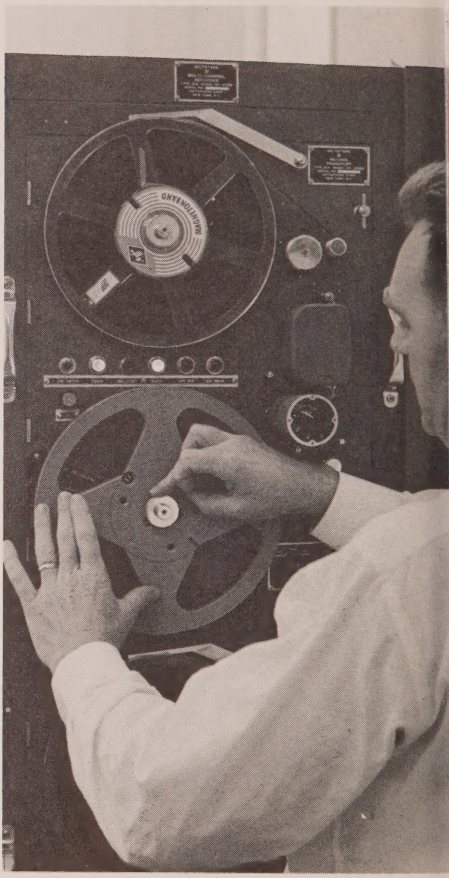


Operating records show that Hydro's bulk transmission system functions with a high degree of reliability. Although the prime responsibility for system security rests at the Control Centre, everyone who works for Hydro is security-conscious—whether planning, designing, building, operating or maintaining electrical facilities, or making an indirect contribution. Everything is geared so peak demands can be satisfied following any probable contingency.

Rarely is the Hydro customer aware of what goes on behind the scenes in maintaining service: helicopters patrolling transmission lines; computers programmed to analyze complex operating problems; foresters trimming tree limbs to avoid contact with conductors; radio-equipped line trucks to speed restoration of power after a sleet storm; skilled linemen using bare hands or special tools to repair a live high-voltage line while it's still carrying power to customers; and highly-trained operators tracking an electrical storm across Ontario and making immediate decisions to avert power interruptions.

Over the years Hydro has installed an array of protective equipment, ranging from a transistorized relay the size of a package of gum to a 25,000 MVA air circuit breaker nearly as high as a two storey house, which senses line trouble, helps locate it and takes corrective action automatically.

Many incidents that used to cause prolonged interruptions now cause only a light blink and power continues to sing through the lines to the customer.



quest for security

But the quest for security never ends because power demands double relentlessly every 10 to 12 years. This means additional expenditures for equipment to safeguard security and a continuing search for better ways of doing things to provide, as far as possible, uninterrupted service.

Since the blackout of November 9, 1965, which left 30 million people in Ontario and the northeastern United States without power, Hydro has spent or committed an estimated $29 million to improve security of service.

New hardware includes sophisticated frequency trend relays developed by Hydro's research division which protect expensive equipment against damage, confine blackout areas and permit speedy restoration of power. Another innovation developed by Hydro is a digital frequency monitor to provide early analysis of network trouble.

Other new equipment includes additional relays, improved recording, monitoring and data-logging instruments and combustion turbine generators to provide emergency start-up power at major thermal-electric stations.

A new microwave system was placed in operation in 1969 to improve communications, data monitoring and protection and control over a large section of Southern Ontario.

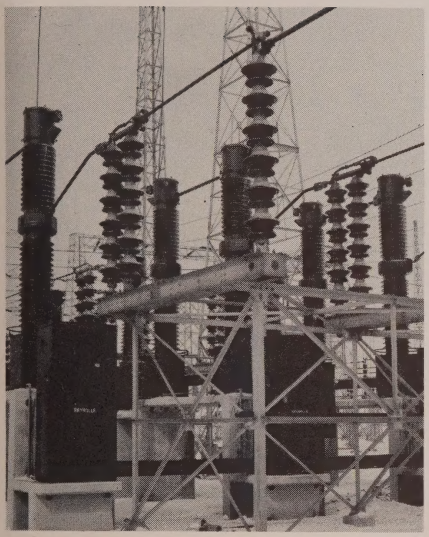
Interconnected utilities in the U.S. have also installed new equipment or revised procedures in the wake of the 1965 blackout.

power pools

But the most significant step has been the formation of the Northeast Power Co-Ordinating Council in January, 1966, which comprises Ontario Hydro and 19 members systems in the U.S. Collectively, the systems have introduced top-level co-ordination of interconnected systems and formed new power pools between groups of closely-related utilities.

Master control centres are being linked by sophisticated communications systems to monitor power flows and take quick preventive or corrective action. The Ontario Centre will be linked directly to the New York Power Pool control centre at Albany, N.Y. and the New England centre at West Springfield, Mass.

Some measures are designed to avert trouble on individual systems and prevent ''cascading'' trip-offs through the interconnected systems similar to 1965. Should power be interrupted, other measures are designed to restore islands of power and to enable operators to rebuild the interconnected network quickly.



Under the new setup, no power pool will be operated in isolation. In the era of larger, more efficient generators and transmission systems capable of shuttling large blocks of power over long distances, the economic facts of life call for greater interdependence.

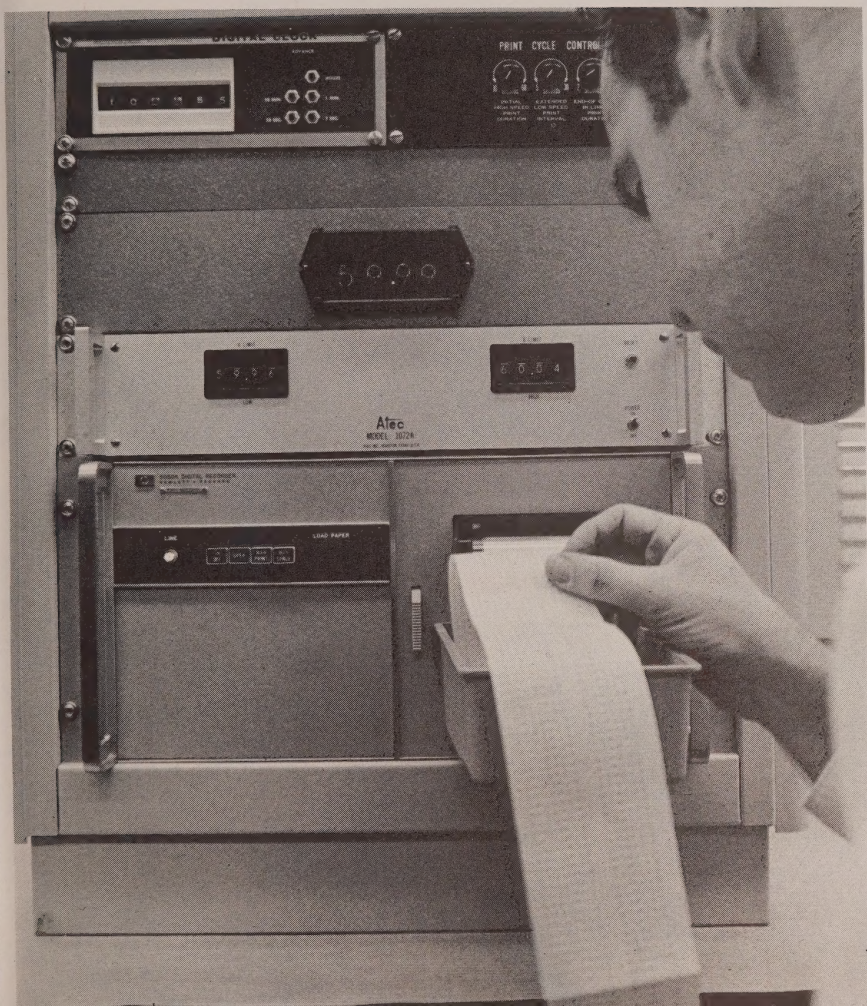
This trend underlines the well-established advantages of inter-system ties to improve security and economy of operation. Some U.S. utilities with heavy air-conditioning loads experience peak demands in summer heat waves. Since Hydro's peak occurs in winter, an exchange of kilowatts often helps both partners to meet their customers' needs.

Efforts have been intensified to seek the maximum benefits of co-ordinated planning and operation through regional organizations like the NPCC. Thus all member utilities may co-ordinate well in advance the addition of new facilities, such as extra-high-voltage lines and major generating stations, and take necessary measures to ensure network stability, economy and reliability. In the U.S., for example, such foresight has enabled small systems with limited funds to share in large coal-fired plants or nuclear power projects.

"watchdog" computer

To keep pace with growing system complexity, Hydro is harnessing new electronic aids to help system operators. An operations task force is working out detailed requirements for a ''watchdog'' computer which will be devoted to monitoring system security from the Control Centre. A remote system annunciator is also being designed—by glancing at a large display panel, the system supervisor will see the open-close position of all circuit breakers on the high-voltage network.

Although much has been accomplished, the search for an uninterrupted supply of power tailored to customers' needs continues. The unending task is to deliver kilowatts when they are needed, in neat, convenient packages and at the lowest possible cost.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